REMARKS

Applicants respond to the official action as follows.

Applicants submit a corrected drawing responsive to the matters raised in paragraphs 1-5 of the Office Action. In the drawing, hatch lines are added to Figure 6. In Figure 4, numeral 18 indicates waveguide pairs, and numeral 11 indicates circuit boards. Numeral 15 does not appear in the drawing, and has been removed from page 15 of the specification.

The text in page 10, lines 21-22 of the specification is intended simply to have a power distribution with positive and negative terminals.

The use in the specification of "transmit" and "receive" in respect of paths, signals and ports admits of the sense of "transmitting" and "transmitter" and of the sense of "receiving" and "receiver" such that the existing phrasing is sufficiently definite for purposes of 35 U.S.C. §112. Claims 1-20 are objected to for the same usage. Reconsideration of this requirement is requested in respect both of the claims and specification.

Claim 13 is amended to delete "three-pair plates".

In amended claims 1, 2, and 6 the letter "w" is enclosed in parenthesis.

The equation (w) = (n)x(n-1)/2 is well-known to those skilled in the art with an understanding of the present

invention as described for example in the paragraph bridging pages 11 and 12 and the paragraph bridging pages 19 and 20. Reconsideration of this requirement is requested.

The use of "cardguide stations" is clear in the paragraph bridging pages 14 and 15, particularly page 15, lines 6-10 as well as Figure 3 of the drawing.

With respect to claim 14, those skilled in the art upon an understanding of the paragraph beginning at page 14, penultimate line, and the paragraph beginning at page 16, line 5, will recognize that the invention provides n x (n-1)/2 waveguide pairs 18 by providing n/2 plates with n/2 waveguide pairs 18 and n/2 plates with (n-2)/2 waveguide pairs 18. So, for even numbers n greater that two, for n/2 plates with n/2 waveguide pairs 18 and n/2 plates with (n-2)/2 waveguide pairs 18, the full mesh requirement is always met. For odd numbers of n greater than two, n plates of n-1 waveguide pairs satisfies the full mesh equation n x (n-1). Reconsideration of this rejection is requested.

Claims 7-11, 18, and 20-22 are amended to respond the rejection under 35 U.S.C. §112.

Claim 6, penultimate line, is amended to correct a mistake in the original claim 6 text.

Claims 7-12, 18 and 20-22 are rejected as anticipated by Popoff.

item within a specific figure, we will respond by listing the differences between Hoffmann/Telesco and Popoff, summarizing those differences and also by examining the entire light path shown in Popoff Figures 1-8.

List of Differences:

The major differences between Hoffmann/Telesco invention and Popoff invention are enumerated below:

1. Our invention contains full-mesh interconnects; Popoff contains broadcast interconnects.
2. Our invention transmits/receives serial data; Popoff transmits/receives parallel data.
3. Our invention contains dedicated paths; Popoff contains shared paths.
4. Our paths are optically isolated; the Popoff paths are intentionally coupled and mixed.
5. Our transmit paths are point to point 1:1; the Popoff transmit paths are point to multipoint (1:N) or multipoint to point (N:1) or both. Our transmit optical power is 1:1; Popoff optical power is 1:2N. Our transmitter sources power to one receiver; the Popoff transmitter sources power to N receivers and N transmitters.
6. Our receive paths are point to point 1:1; Popoff receive paths are N:1. The receiver in our invention receives

power from one source transmitter; the receiver in the Popoff invention receives power from N source transmitters.

7. Our transmitter sources optical power to one circuit board; The Popoff transmitter sources power to N circuit boards.
8. The receiver in our invention receives optical power from one circuit board; the receiver in the Popoff invention receives power from N circuit boards.
9. Our invention has no single-point of failure; Popoff has many single-points of failure.
10. Our invention contains dissimilar plates; Popoff contains identical couplers.
11. Our invention does not contain fiber-optic cable; Popoff contains fiber-optic cable.
12. Our invention contains separate transmit and receive paths (1:1); Popoff contains shared transmit and receive paths (N:1:2N) where each receiver can receive up to N simultaneous transmissions and each transmitter must source 2N destinations (N receivers plus all N transmitters);
13. Our invention contains direct board to board connection; Popoff contains indirect board to board connections through star couplers, fiber optic cables and mixers.
14. Our invention contains multiple discrete signals per waveguide plate; Popoff contains a single signal per star

coupler.

15. Our invention contains drawings and text that clearly describe the circuit board to backplane surface connection; Popoff does not contain a drawing or text that shows the optical surface connection between the circuit board and the backplane.

16. Our invention contains waveguide paths only in the backplane; Popoff contains waveguide paths that are on the circuit board, in the fiber optic cables and in the backplane. Popoff circuit board waveguide paths are integrated with the transceiver and would therefore be considered electro-optical, or active devices by those skilled in the art. Backplanes are not active, they are passive.

17. Our invention contains one level of interconnect between circuit board and backplane; Popoff contains multiple levels of interconnect between the circuit board and backplane.

18. Our invention provides simultaneous (n x (n-1)) connections with (n x (n-1)) optically isolated optical signals; Popoff's claims M x N optical signal lines only form N connections.

Summary of Differences:

We do not believe that claims 7-12, 18 and 20-22 were anticipated by Popoff. We have demonstrated advantages over the Popoff invention that allowed us to meet the clearly stated objects of our invention. We object to the rejection on the grounds that Popoff does not anticipate a full mesh interconnect. Popoff intentionally violates optical isolation and Popoff has an alignment means that is limited to fiber optic cables. We do not use fiber optic cables in our design and we create no broadcast signals. We acknowledge inventions such as the Popoff invention our disclosure.

The Popoff invention performs the function of optical mixing, optical coupling and optical sharing of signals. If the Popoff signals are not mixed, coupled and shared then the Popoff invention will not work. The converse is true for our design. Our invention performs the function of optical isolation of all paths. If our signals are not optically isolated then our invention will not work.

The Popoff invention performs the function of broadcast optical interconnect. If the Popoff signals are not broadcast then the Popoff invention will not work. The converse is true for our design. Our invention performs the function of direct full mesh optical interconnect. If our signals are not directly connected in a full mesh then our invention will not work.

Since the paths in the Popoff invention are shared by a plurality of signals, those skilled in the art would recognize that the signals must be multiplexed by performing time division multiplexing or wave division multiplexing or by some other means of multiplexing or arbitration. Since the paths in our invention are not shared we do not have to perform multiplexing of the signals. Our invention provides superior bandwidth for the transmission of signals when compared to the Popoff invention.

Our design carries a plurality of optically isolated transmit and receive pairs on each waveguide plate in the backplane. Popoff does not carry a plurality of optically isolated pairs in his waveguide structures. In Popoff, each backplane waveguide carries only one shared, mixed, broadcast signal. His backplane waveguides never carry dedicated optically isolated pairs of signals. The backplane waveguides in Popoff actually provide mixing, coupling and sharing of optical signals. This is contradictory and opposite to our optically isolated, dedicated connections. The waveguides in Popoff figures 1, 5, 6 and 7 are not actually part of the backplane system, they are clearly shown mounted to the circuit board assembly 10 and described in the specification in the same manner. Given that they are part of the transceiver they are active components, not passive. Furthermore they are part of the

circuit board assembly, not the actual backplane itself. They are part of the replaceable circuit board assembly and not part of the permanent backplane assembly itself. Those skilled in the art will realize that the circuit board assembly is never considered part of the permanent backplane assembly but rather a replaceable and field-upgradeable part of the system. Those skilled in the art would recognize that the optoelectric bus transceivers are not part of the backplane assembly since they do not make physical contact with the backplane assembly; they are physically separated by the board edge connectors 13. Additionally, although Popoff mentions the board edge connectors 13 twice in his specification, he never actually describes them. We specifically state that our invention requires no fundamental changes to the construction of related circuit board assemblies in our disclosure; Popoff clearly requires fundamental changes to the construction of related circuit board assemblies yet he does not specify how the transceiver 18 becomes connected to the optical signal lines 19 on the circuit board 10.

Examination of the Entire Light Path

Optoelectric bus transceiver 18:

Figure 1 of Popoff shows optoelectric bus transceivers 18 mounted on circuit board 10. Figure 1 also clearly shows shared transmit and receive paths. Our transmit and receive paths are

optically isolated. The line of demarcation separating the circuit board from the backplane assembly exists (at a minimum) at the pair of multi-fiber board edge connectors 13 (those skilled in the art would argue that the true line of demarcation exists at the v-groove array 40). Those skilled in the art would recognize that the optoelectric bus transceivers are not part of the backplane assembly since they do not make physical contact with the backplane assembly; they are physically separated by the board edge connectors 13. We acknowledge that we also use transceivers but we make no claims about them, especially not that the transmitting and receiving portions share a common optical path.

Pair of multi-fiber board edge connectors 13:

Both board edge connectors illustrated in Figure 1 of Popoff carry shared signals, not optically isolated signals. The paths in these board edge connectors carry both transmit and receive signals within the same shared path. All of our paths are isolated; they are not shared as in Popoff. One of the two edge connectors is shown mounted to the circuit board assembly 10. Those skilled in the art would recognize that this connector is not considered part of the backplane assembly since it is mounted on the circuit board 10 and is on the circuit board side of the demarcation line separating the backplane from the circuit board. Those skilled in the art would recognize that

the circuit boards 10 function as removable, replaceable and field-upgradeable assemblies within the system chassis whereas the backplane is a permanent assembly within the system chassis. The other board edge connector shown in Figure 1 of Popoff functions as a mechanical termination and means to secure the fiber optic cable 12 and has paths that carry both transmit and receive signals within the same shared path. All of our paths are isolated; they are not shared as in Popoff. Our invention does not use fiber-optic cable as in Popoff.

Fiber-optic ribbon cables 12

The fiber-optic ribbon cable shown in Figure 1 of Popoff carries shared signals, not optically isolated signals. Each and every individual fiber-optic cable within the fiber-optic ribbon cable is a shared path that carries both transmitted and received data and may also serve as a contention path for multiple transmitters. The paths in the fiber-optic cable are shared; they carry both transmit and receive signals within the same shared path. All of our paths are isolated; they are not shared as in Popoff. In addition, those skilled in the art would recognize that these fiber-optic cables are not waveguide plates. Our invention does not use fiber-optic cable as in Popoff.

Identically configured v-groove arrays 40:

The v-groove arrays perform the function of mechanical termination and securing of the fiber-optic ribbon cable 12. The paths in these v-groove arrays carry both transmit and receive signals within the same shared path. All of our paths are isolated; they are not shared as in Popoff. Our invention does not use fiber-optic cable as in Popoff.

Identical reflective star coupler 26 and mixing guide channel 30:

Figure 1 of Popoff shows a reflective star coupler 26 and mixing guide channel 30. This star coupler does not perform the function of isolating light paths. In fact it receives its name based on the fact that it performs the function of "coupling" or mixing the signals together for the purposes of broadcast transmission of the signals. Our invention performs the function of a full mesh interconnect by isolating the individual signals, not "coupling them". The mixing guide channel derives its name from the fact that it "mixes" signals. Our invention isolates signals, it does not mix. In addition our waveguide plates are dissimilar; Popoff describes the star couplers as identical.

Figures 5, 6 and 7:

Figures 5, 6 and 7 of Popoff show optoelectric bus transceivers mounted on circuit board 10. Figures 5, 6 and 7 of

Popoff clearly show shared transmit and receive paths. Our transmit and receive paths are optically isolated. Furthermore, these transceivers are described as opto<u>electric</u> devices, our invention is optical, not optoelectric. Those skilled in the art would recognize that Figures 5, 6 and 7 of Popoff are active, powered devices and not passive. Our backplane is passive. These transceivers are mounted on circuit board 10. Those skilled in the art would recognize that they are not part of the backplane assembly. Those skilled in the art would recognize that the line of demarcation separating the circuit board from the backplane exists at the pair of multi-fiber board edge connectors 13. Those skilled in the art would recognize that figures 5, 6 and 7 of Popoff are not part of the backplane assembly. Those skilled in the art would recognize that the circuit boards 10 function as removable, replaceable and field-upgradeable assemblies within the system chassis (similar to our item 11, for which we make no claims) whereas the backplane is a permanent assembly within the system chassis. Those skilled in the art would recognize that the optoelectric bus transceivers are not part of the backplane assembly since they do not make physical contact with the backplane assembly; they are physically separated by the board edge connectors 13.

Figure 8:

Figure 8 of Popoff illustrates a preferred procedure for fabricating the reflective star coupler. Figure 8 of Popoff contains input waveguides 83 and output waveguides 85 and a mixing region 90. This star coupler does not perform the function of isolating light paths. In fact it receives its name based on the fact that it performs the function of "coupling" or mixing the signals together for the purposes of broadcast transmission of the signals. Our invention performs the function of a full mesh interconnect by isolating the individual signals, not "coupling them".

Accordingly, the examiner is urged to withdraw the rejection of the claims on the basis of Popoff. Those skilled in the art would acknowledge that our invention does not and should not rely on the invention of Popoff.

The citation of Alferness is noted. Since the examiner has cited Alferness and the apparent similarity regarding stacks of plates, we now describe how Alferness differs from the use of plates in the present invention.

Alferness discloses the use of waveguide plates on a circuit board in a structure suitable for a crossbar switch. Alferness' invention is never described for use as a backplane. Furthermore, Alferness' invention is described as being <u>electro-</u> optical requiring active circuitry whereby our invention is

purely optical and passive and does not require active circuitry. Alferness intentionally splits and combines optical paths to form a switch whereas we intentionally isolate all optical paths and perform no switching whatsoever. Alferness uses identical plates, our plates are dissimilar. Alferness' plates are either input or output, but not both. Our waveguide plates are both input and output. Alferness describes plates made with x-cut and z-cut lithium niobate crystals or single-cut crystals with the use of Faraday rotators or polarization converters; we describe waveguide plates made with machining or injection molding operations (no exotic materials or processes are specified). Alferness describes the sensitivity of his invention to the polarization of the transmitted light as it leaves the output plate and enters the input plate; we have no specific notion of output plates and input plates, we describe no plate-to-plate interconnection nor do we cite any sensitivity to polarization angles. Alferness describes lenses that may be needed to compensate for plate to plate coupling loss; we describe no such lenses or losses attributable to switches, Faraday rotators or polarization converters. Alferness does not describe how his invention might be used to interconnect a set of transmitters and receivers on one circuit board to the transmitters and receivers on a plurality of other circuit boards; our invention clearly shows how to interconnect a set of

transmitters and receivers on one circuit board to the transmitters and receivers on a plurality of other circuit boards. In fact, were we to assume that a pair of circuit boards were to be interconnected by the Alferness invention; we would have to conclude that one of the circuit boards only transmits information and the second circuit board only receives information. Those skilled in the art would recognize that this topology has only limited usefulness.

The examiner is now urged to withdraw the election requirement and allow claims 1-22 pending in the application including non-elected claims 4, 5, 12, 16, 17 and 19 for the following reasons:

(i) Claim 1, now allowable, is generic to claims 4 and 5;

(ii) Claim 12 is a generic claim. Applicants submit that there is no patentable distinction between a backplane and a midplane. Both are classified in the same art. Moreover, the use of a backplane or a midplane in practice of the invention is a matter of design or architectural choice within the competence of those skilled in the art;

(iii) Claims 16 and 17 depend from claim 14 and each recites a particular form of the generically claimed backplane of claim 14. Claim 19 is drawn to a

backplane comprising rectilinear and circular midplane sections. Again, selection of rectilinear (cl.14) and rectilinear and circular (cls. 17 and 19) waveguide plates is a matter of design choice.

In the event the Examiner persists in any of the rejections, it is respectfully requested that the Examiner telephone the undersigned attorney for applicant in order to discuss the application and to expedite prosecution thereof.

Stamford, Connecticut
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Respectfully submitted

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